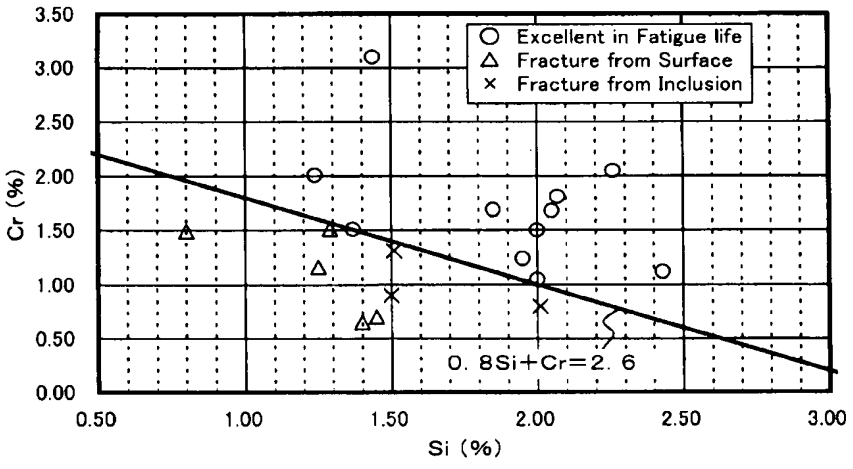
REMARKS/ARGUMENTS

Claims 1-4 and 8-14 have been amended in a formal, non-substantive manner as requested by the Examiner. As the scope of the claims has not changed and as these issues were not earlier raised, the amendments should be entered.

The Examiner has maintained the rejections over Nagao and has made a new rejection over Hashimura on the basis that the broad disclosure of steel compositions in the references overlaps with that presently claimed. However, and with regard to this alleged overlap, the ample data present in the specification showing distinct differences in properties between steels falling within the present claims and similar steels whose compositions fall just outside the present compositional limitations appears to have been improperly dismissed by the Examiner.

For example, Table 1 of the present specification plots the data from many experiments showing that when a spring steel is provided that meets the compositional limitations according to the present claims and satisfies the formula $0.8x[Si]+[Cr] \geq 2.6$ that excellent fatigue life is obtained, whereas when one operates outside of this formula the spring steels provided show fracture:



This fact, by itself, is sufficient to establish to the patentability of the present claims regardless whether the references broadly disclose compositional ranges that overlap with the presently claimed compositional ranges because neither applied reference discloses or suggests the relation noted above regarding the contents of silicon and chromium present in every pending claim.

The Table 1 of data at specification page 9 presents 19 examples, many if not all of which the Examiner would consider suggested by the applied references. However, the results provided by this Table make it clear that there are distinct differences in properties between steels falling within such broad compositional limitations:

TABLE 1

	Chemical compositions (% by mass)*										Grain size
Examples	C	Si	Mn	P	S	Ni	Cr	V	Mo	Al	number
1	0.75	2.00	0.75	0.010	0.009	0.00	1.50	0.21	0.00	0.003	10.5
2	0.60	1.95	0.69	0.008	0.007	0.00	1.24	0.32	0.00	0.002	10.5
3	0.59	1.44	0.68	0.008	0.011	0.00	3.10	0.18	0.00	0.002	11.0
4	0.53	2.07	1.22	0.005	0.006	0.00	1.81	0.11	0.00	0.002	11.0
5	0.72	1.85	0.85	0.006	0.011	0.18	1.69	0.24	0.00	0.003	10.5
6	0.52	2.26	0.94	0.008	0.005	0.00	2.05	0.23	0.28	0.035	10.0

TABLE 1-continued

7	0.61	2.00	0.85	0.013	0.005	0.25	1.05	0.11	0.00	0.001	10.5
8	0.78	1.24	0.67	0.007	0.008	0.00	2.01	0.16	0.00	0.003	11.0
9	0.63	2.43	0.71	0.009	0.007	0.43	1.12	0.12	0.00	0.003	10.5
10	0.61	2.05	0.32	0.008	0.010	0.00	1.68	0.27	0.00	0.002	12.0
11	0.68	1.37	0.47	0.015	0.012	0.00	1.51	0.17	0.00	0.003	11.5
12	0.55	1.45	0.70	0.010	0.009	0.00	0.70	0.00	0.00	0.003	9.5
13	0.63	1.40	0.60	0.007	0.012	0.00	0.65	0.11	0.00	0.003	10.0
14	0.60	1.50	0.70	0.011	0.010	0.25	0.90	0.06	0.00	0.041	10.0
15	0.59	1.29	0.75	0.008	0.014	0.00	1.51	0.00	0.09	0.002	10.5
16	0.72	0.80	0.78	0.006	0.009	0.00	1.49	0.05	0.15	0.002	11.0
17	0.65	2.01	0.90	0.005	0.005	0.00	0.80	0.15	0.00	0.001	10.0
18	0.59	1.51	0.83	0.007	0.012	0.00	1.31	0.23	0.00	0.003	10.5
19	0.68	1.25	1.22	0.011	0.009	0.00	1.16	0.35	0.00	0.003	10.5

Examples	Calculated 0.8Si + Cr	Fatigue life ($\times 10^6$ cycles)	Initiation of fracture	Residual shear strain (%)	Residual shear strain after nitriding (%)
1	3.1	20	—	0.041	0.038
2	2.8	20	—	0.037	0.051
3	4.3	20	—	0.029	0.030
4	3.5	20	—	0.045	0.039
5	3.2	20	—	0.025	0.033
6	3.9	20	—	0.038	0.029
7	2.7	20	—	0.047	0.059
8	3.0	20	—	0.033	0.041
9	3.1	20	—	0.041	0.063
10	3.3	20	—	0.029	0.031
11	2.6	20	—	0.039	0.041
12	1.9	5.0	Surface	0.075	0.079
13	1.8	7.8	Surface	0.064	0.081
14	2.1	7.0	Oxide inclusions	0.065	0.075
15	2.5	10.3	Surface	0.059	0.059
16	2.1	4.3	Surface	0.084	0.081
17	2.4	1.7	Oxide inclusions	0.049	0.055
18	2.5	8.3	Oxide inclusions	0.055	0.055
19	2.2	12.7	Surface	0.102	0.105

*The balance is Fe and inevitable impurites.

As is apparent from Table 1 and FIG. 1, the spring steels obtained in Examples 12 to 14 and 16 to 17 have shorter fatigue lives because of differences in at least Si or Cr. As shown in Examples 15 and 18 to 19, these spring steels also show a need for further improvement in fatigue life, with a fracture (a fracture below fatigue limit) originating from oxide inclusions occurring in Example 18. In contrast, as shown in Examples 1 to 11, the spring steels according to the invention and containing Si and Cr within the claimed limits and relationship showed significantly improved fatigue life and sag resistance. Springs obtained in Examples 1, 3 to 6, 8, and 10 to 11, which contain Cr in an amount greater than those of the springs in Examples 2, 7, and 9, were also improved in the sag resistance after nitriding.

What would drive one of ordinary skill in the art to minimize the aluminum content in Nagao? As explained in Applicants' previous response, Nagao relies upon the presence of inclusions, while minimizing aluminum *reduces* the formation of oxides (specification page 5, bottom). The Examiner comments that the present claims do not include a limitation on

inclusions, but this misses the point. The point here is that Nagao teaches away from Applicants' aluminum limitation even if broadly encompassed within a disclosed overall range of less than or equal to 0.1%. Table 1 above shows that it is quite possible to operate inside the broad compositional limitations of Nagao and obtain very poor materials. Nagao does not disclose or suggest the particular combinations here claimed, nor does the reference recognize the substantial benefits obtained when one does operate within the presently claimed ranges (see both the Figure and Table above). The fact that Nagao does not recognize the benefits stemming from Applicants' composition *establishes* patentability. See MPEP 716.02.

The Examples of record in the present specification demonstrate that spring steels containing contents of Si and Cr in the amounts presently claimed and, importantly, present an amount such that the formula $0.8[Si] + [Cr] \geq 2.6$ is met are significantly improved in both fatigue life and sag resistance. On the other hand, very similar spring steels also falling within the broad disclosures of the applied references but which do not meet the presently claimed limitations with regard to Si and Cr, etc. show quite poor fatigue life. As neither Nagao nor Hashimura disclose or suggest that such substantially improved properties can be obtained by operating within the limitations discovered by Applicants, the pending claims are deserving of allowance as they describe a significant advance in the art.

Accordingly, and in view of the differences between what is claimed herein and what is disclosed by the references Applicants respectfully submit that the present application is in condition for allowance, and early notification to this effect is respectfully requested.

Respectfully submitted,

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